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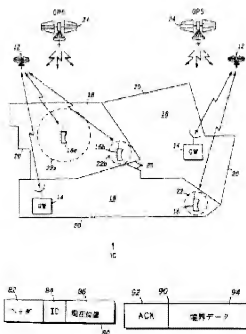
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(54) MOBILE UNIT TRACING SYSTEM

(57)Abstract:

PURPOSE: To provide a tracing system in which communicating amounts necessary for maintaining valid position data are minimized.

CONSTITUTION: A communication network 10 traces the position of a mobile unit 16 using it. The mobile unit decides the present position by using a signal transmitted from satellites 12 and 24 over the head by power-up, and then transmits a data communication message 80 indicating the position to the network. The network preserves the position, and returns a data message 90 indicating a boundary line 22 surrounding the position of the mobile unit. The mobile unit regularly and repeatedly judges the present position. Then, when the present position is outside the preliminarily



normalized boundary line, another position data message 80 is transmitted to the network, the position data maintained by the network are updated, and the normalization of a new boundary line 22 is received.

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CLAIMS

[Claim(s)]

[Claim 1] Are a mobile unit the method of pursuing and this method, In a stage of receiving a data message (94) which shows a boundary line in said mobile unit (16), and said mobile unit (16), A stage (78) of judging a case where said mobile unit is in the outside of said boundary line, And a method of pursuing a mobile unit providing a stage (79) which transmits a current position data message (86) which shows a current position of said mobile unit (16) to said mobile unit (16) when said mobile unit is in the outside of said boundary line.

[Claim 2] Are a mobile unit (16) the method of pursuing, and this method, It is the stage of generating the original position data (74) in said mobile unit (16), In a stage (79) which transmits a data message which shows a position of said origin from that position data of said origin indicates the original position of said mobile unit to be, and said mobile unit, and said mobile unit, How to pursue a mobile unit (16) possessing a stage (88) of receiving a data message (94) which shows a boundary line.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention generally relates to a tracking system (tracking systems). This invention relates to the tracking system which maintains the data in which the position of a mobile unit is shown more at details.

[0002]

[Description of the Prior Art]A tracking system uses radio, in order to discover the whereabouts of a mobile unit occasionally. One example of such a tracking system is used by the communication network which provides communications service with a mobile radio transmitter-receiver. The radio message which is not visible to a walkie-talkie user (transparent) continues notifying the position of the move transmitter-receiver which has received communications service in the central controller with this network.

[0003]Position data is extremely worthy for a communication network. A network enables it to draw communication with the most sufficient convenience through the node of this network getting to know the position of a mobile unit. It enables it to suit in a network the various rules and procedures which a network may be imposed with various political substance which operates in the territorial jurisdiction. For example, one territorial jurisdiction may permit network employment only in the frequency of the 1st group, and the territorial jurisdiction which adjoins on the other hand may permit network employment only within the frequency of the 2nd group. It may be applied to the communications service used with the mobile unit which operates in the territorial jurisdiction where different customs duties differ from a tax.

[0004]

[Problem(s) to be Solved by the Invention]It is clear that position data's it is better as it becomes more exact. More exact data enables it to check more the time of a network crossing to the territorial jurisdiction of one territorial jurisdiction to others [mobile unit] to fitness.

However, the strong necessity of cost increasing generally in proportion to the accuracy of position data, keeping cost as low as possible, and keeping an income as high as possible exists. It is the quantity of the communication resource consumed when maintaining the important position data of the present [one] of cost especially. The resources which can be exploited since it is used by a communications service member and an income is generated decrease more, so that it will be carried out, if more resources are consumed when maintaining the present position data. A mobile unit often carries out battery operation, and communication of a superfluous quantity leads to excessive use of available battery electric power.

[0005]Therefore, it is the purpose of this invention to provide the improved tracking system, and it is an advantage.

[0006]It is other purposes of this invention to provide the tracking system which minimum-izes quantity of communication required in order to maintain effective data, and it is an advantage.

[0007]It is the purpose of further others of this invention to provide a programmable tracking system so that the necessity for various position reports that a mobile unit is imposed by various fields which operate in it can be suited, and it is an advantage.

[0008]

[Means for Solving the Problem and its Function]The above, other purposes, and an advantage of this invention are realized by a method of pursuing a mobile unit with one gestalt. In a mobile unit, this method requires reception of a data message which describes a boundary line. A mobile unit judges a time of next this mobile unit being in the outside of this boundary line. When this mobile unit is in the outside of a boundary line, this mobile unit transmits a current position message which describes a position of a mobile unit at that time.

[0009]The above, other purposes, and an advantage of this invention are attained by a method of pursuing a mobile unit with other gestalten. It is required that the method should receive the original position data from a mobile unit. Data of a position of these origin describes the original position of this mobile unit. Data of the original position of these is saved and a data message is transmitted to this mobile unit. This data message describes a boundary line surrounding a position of said origin.

[0010]

[Example]Being able to acquire a more perfect understanding of this invention by referring to the following detailed explanation and Claim with Drawings, in Drawings, the same reference number shows the same item over each figure.

[0011]Drawing 1 shows one of many of the different fields of the earth where the communication network 10 operates. In desirable working example, the network 10 contains the artificial satellite 12 which goes the orbit of the earth around. The satellite 12 may be moving about the earth, may be standing it still (that is, it is in a geostationary orbit), or may

contain some each. It thinks including such all the composition [term / which is used here / "an orbit is gone around" (orbit)] "goes an earth orbit around" (orbit the earth) again.

Communication can be drawn through the gateway 14 through the satellite 12. The gateway 14 is arranged as an institution fixed on the ground. The satellite 12 and the gateway 14 act as the node (node) for the network 10. the arbitrary terminals in which the gateway 14 was connected to the public exchange telecommunications network (PSTN), and communication was combined with PSTN by it through the network 10 -- or it enables it to lead from the arbitrary terminals combined with PSTN

[0012]The network 10 provides communications service to arbitrary numbers of mobile units 16. As the name shows, the mobile unit 16 is movable to one of specific positions from not a thing but a place for exclusive use in a place. The mobile unit 16 contains the device which can be easily conveyed barely with portable stock molding equipment. The mobile unit 16 establishes the neighboring satellite 12 and data communication link, and this satellite 12 relays the data communications to the neighboring gateway 14 next.

[0013]The mobile unit 16 operates in the arbitrary things of much different political or political territorial jurisdiction 18. The territorial jurisdiction 18 is surrounded by the political or political boundary line 20. Generally, the boundary line 20 has irregular shape. The network 10 gets to know when the mobile unit 16 went across the boundary line 20, and frequency assignment, fee collection, a tax, and other parameters need to enable it to set it up according to the suitable territorial jurisdiction 18 by it. It gets to know where even if the network 10 is compared again and is not so exact, the mobile unit 16 is, and a call needs to be made to draw by it the best through the satellite 12.

[0014]As shown the mobile unit 16 by the mobile unit 16a, when it is located in the territorial jurisdiction 18, it is not close to the boundary line 20. As a result, it is only that the network 10 needs the comparatively inaccurate data about the position of the mobile unit 16a. The mobile unit 16a may move a comparatively big distance, before it approaches the boundary line 20. This big distance is shown by the radius of the surrounding circle of the mobile unit 16a. This circle forms the boundary line 22a.

[0015]On the other hand, as the mobile unit 16 is shown by the mobile unit 16b, when it is near the boundary line 20, the network 10 needs the comparatively exact data about the position of the mobile unit 16b. The mobile unit 16b can go into other territorial jurisdiction 18 by moving a comparatively small distance so that it may be shown by the radius of the boundary line 22b.

[0016]The mobile unit 16 determines the position of these selves selectively at least so that it may explain in detail by the following. In desirable working example of this invention, when the mobile unit 16 makes this decision, it uses the global positioning system 24 like Global Positioning System (GPS). The system 24 includes the group of the artificial satellite which turns around the orbit of the earth. The satellite of the system 24 may be the same as the

satellite 12, or may differ. This is not an indispensable thing although the satellite of the system 24 differs from the satellite 12 in typical working example. Traditional art is used in order that the mobile unit 16 may supervise and process the signal transmitted by the system 24 in order to determine the position of these very thing. Although it is on account of explanation and this invention is not limited, and operation of the system 24 is described to the GPS position arrangement system, the person skilled in the art will understand that other spotting systems can be used.

[0017]In a general expression, the tracking system of this invention uses the gateway 14 of the mobile unit 16 and the network 10. The satellite 12 operates as a node for relaying the data communications between the mobile unit 16 and the gateway 14. In order that each mobile unit 16 may determine the position of itself and may tell the network 10 about the position, in the nearby "local" gateway 14, it transmits data communications to the network 10. When the gateway 14 receives the position communication, it generates the data which specifies the boundary line 22, and returns these boundary layer data to the mobile unit 16. As long as it is operating within the boundary line 22 as which the mobile unit 16 was specified, it does not need to notify the whereabouts to the network 10. However, when the mobile unit 16 moves to the outside of the boundary line 22, it transmits new position communication to the network 10, and receives new boundary layer regulation according to it.

[0018]Therefore, the tracking system of this invention makes the minimum the number of communication messages required in order to maintain an effective value. As shown by the mobile unit 16a and the boundary line 22a, when the data which is not so exact is permitted, the low data of correctness is maintained by some position communication messages. More exact data is maintained by more position communication messages when more exact data is required, as [drawing 1](#) is shown by the mobile unit 16b and the boundary line 22b.

[0019][Drawing 2](#) shows the block diagram of the mobile unit 16. The mobile unit 16 contains the transmitter-receiver 26 which transmits a signal and is received in the format which is compatible with the satellite 12 and the network 10 (see [drawing 1](#)). These signals contain the data message which can be made to carry out the data communications of the mobile unit 16 with the neighboring satellite 12. The data communications of the mobile unit 16 can be carried out to other arbitrary nodes of the network 10 like the neighboring gateway 14 (see [drawing 1](#)) via this satellite 12 again. For example, the receiver 28 for spotting of the mobile unit 16 like a GPS receiver generates the data which receives the signal broadcast by the positioning system 24 (see [drawing 1](#)) and in which the current position of the mobile unit 16 is shown. Both the transmitter-receiver 26 and the receiver 28 are combined with the processor 30. The processor 30 is further combined with input/output (I/O) section 32, the timer 34, and the memory 36. The I/O section 32 is used in order to collect user inputs like operation of an electric power switch, and in order to collect the telephone numbers for setting up a call. The

processor 30 uses the timer 34, in order to maintain the present time. The memory 36 contains in the mobile unit 16 the data which performs the procedure of explaining below, when the processor 30 performs including the data which acts as a command to the processor 30. The memory 36 contains the variable, table, and database which are operated by operation of the mobile unit 16.

[0020]Drawing 3 shows the block diagram of the gateway 14. The gateway 14 contains the transmitter-receiver 38 which transmits a signal and is received in the format which is compatible with the satellite 12 (see drawing 1). these signals -- the gateway 14 -- the neighboring satellite 12 -- and arbitrary numbers of mobile units 16 and the data message which can be made to carry out data communications are included. The transmitter-receiver 38 is combined with the processor 40. The processor 40 is combined with the I/O section 42, the timer 44, the memory 46, and PSTN interface 48 again. The I/O section 42 receives an input from a keyboard and other input devices, and provides a display terminal, a printer, and other output units with data. The processor 40 uses the timer 44, in order to maintain the present time. The memory 46 contains the semiconductor for memorizing the data which makes the gateway 14 perform the procedure of explaining below, and the memory storage of magnetic and others, when it acts as a command to the processor 40 and the processor 40 performs. The memory 46 contains the variable, table, and database which are operated by operation of the gateway 14. The gateway 14 communicates with PSTN with the interface 48.

[0021]Drawing 4 shows the flow chart of the power up procedure 50 performed with the mobile unit 16 according to this invention. Procedure 50 is performed always, when the mobile unit 16 is energized. The task 52 performs initialization in the mobile unit 16. The person skilled in the art will understand between initialization that many memory locations can set it as a predetermined value. As shown in drawing 5, the position table 54 is memory structure which the mobile unit 16 maintains in the memory 36 (see drawing 2). The table 54 contains the data element explained in detail by the back. If it returns to drawing 4, the task 52 will set at least one of these data elements to a predetermined value. As soon as the positioning procedure of explaining below with reference to drawing 6 evaluates the data element by which it was initialized, a value predetermined [this] is chosen so that it may determine that it is required to transmit a position communication message to the gateway 14. As a result, the mobile unit 16 makes a position communication message the task 52 transmit to the gateway 14 according to energization of the mobile unit 16.

[0022]The task 56 synchronizes the transmitter-receiver 26 after the task 52 for communication with the neighboring satellite 12. The mobile unit 16 can be engaged in data communications with the network 10 after the task 56. The mobile unit 16 is registered into the network 10 in the task 58. This registration is attained by suiting a certain intrinsic proof (authentication) procedure which transmits to the gateway 14 which has served identification data, and is

imposed by the network 10. The served gateway 14 is determined by the neighboring satellite 12 in the beginning in the process which is not in sight of the mobile unit 16 and the both sides of the gateway 14 which have given their service. The mobile unit 16 is ready to transmit a call or receive after registration. While standing by the user input which the mobile unit 16 enters and orders it a call or an outgoing call, it operates by the standby mode 60. When a call occurs from the standby mode 60, it can go into the call-processing mode 62, and can return from this mode. When power down of the mobile unit 16 is carried out, it goes into the power down mode 64. When it is energized, the mobile unit 16 leaves the power down mode 64, and repeats the power up procedure 50.

[0023]Drawing 6 shows the flow chart of the positioning procedure 66. The mobile unit 16 carries out repeat execution of Procedure 66 to a regular schedule, while it is operating in either the standby mode 60 or the call-processing mode 62 (see drawing 4). In desirable working example, this regular schedule may change from 1 degree to several minutes or 1 degree per several hours every several seconds.

[0024]It is judged whether between Procedures 66, the mobile unit 16 can be used in order to use it when the inquiry task 68 is performed and the signal from the positioning system 24 (see drawing 1) determines the position. In the usual operation, the system 24 is available and is the desirable art for determining a position. Therefore, when the system 24 is available, the mobile unit 16 performs the task 70 using the spotting receiver 28 (see drawing 2), and receives the signal from the system 24. The task 70 obtains 1 set of parameters which process the signal with a traditional form and show a current position.

[0025]On the other hand, in order that the network 10 may prevent that it is thoroughly dependent on the system 24, this invention includes the backup technique for determining a current position. Therefore, when the system 24 cannot be used, a current position is determined from the signal which the task 72 is performed and is transmitted by the satellite 12 of the network 10. In desirable working example, the satellite 12 operates around those orbits in o'clock in about 25,000 km /about the earth. Therefore, the signal of these satellites receives the Doppler (Doppler) shift of most quantity, and this Doppler shift changes, when a satellite passes along overhead location. The satellite 12 transmits the position data of a cell. As a result, when combined with the position data of a cell, the task 72 supervises the range (range) and range rate (range rate) data, in order to obtain the Doppler sign (Doppler signature) corresponding to the position of the mobile unit 16. The backup technique whose intention it has in the task 72 may be a low speed, and may be lower than the spotting art of the task 70. [of accuracy] Nevertheless, such backup position data is more preferred than there is also no position data.

[0026]After the current position of the mobile unit 16 is determined in either of the task 70 or 72, the task 74 saves the present position data, and evaluates the current position about the

present boundary layer 22a-22b (see [drawing 1](#)) established to the mobile unit 16. When it returns to [drawing 5](#), the position table 54 contains the data elements 76 and 77 used, respectively in order to memorize present position data and boundary layer data.

[0027]In order that the task 70 may determine a current position, when it is used, present position data shows latitude and longitude preferably. A term "latitude (latitude)" and "longitude (longitude)" are considered including other arbitrary standards or measuring technique which can identify a position as used here. In one working example of this invention, boundary layer data shows the minimum and maximum latitude and longitude. Therefore, it is convenient that the boundary line 22 is a quadrangle or a rectangle. It is judged whether the task 74 has a current position in the outside of the boundary line 22 in a current position as compared with the boundary line 22.

[0028]In another working example of this invention, boundary layer data shows the distance interpreted as a radius (radius). The data element 79 of the position table 54 (see [drawing 5](#)) shows the original latitude and longitude of the position. It is investigated whether the task 74 is in a big distance from the original position rather than some compare that current position and the mobile unit 16 is indicated to be with this radius. In this working example, the boundary line 22 forms the circle which has a radius which has a center in the original position and is specified with boundary layer data, as shown in [drawing 1](#). It is judged whether the task 74 has the mobile unit 16 in the outside of the boundary line 22 again. Boundary layer data is not limited to what shows a quadrangle, a rectangle, or a circle, but the person skilled in the art will understand that the arbitrary shape containing the shape of the political territorial jurisdiction 18 can be shown.

[0029]After the task 74, if the inquiry task 78 has a current position of the mobile unit 16 in the outside of the boundary line 22, it will lead programmed control to the task 79. The task 79 transmits the data message 80 of a current position to the network 10. [Drawing 7](#) shows the block diagram of the desirable format for the message 80. Especially the message 80 to the header 82 for notifying the network 10 that it is a current position message, and the network 10. The present position data 86 in which ID84 for reporting which mobile unit 16 has transmitted the message and the current position of the mobile unit 16 are shown by latitude/longitude or other parameter forms is included.

[0030]If it returns to [drawing 6](#), Procedure 66 will stand by until the task 88 receives the response message 90 from the network 10 after the task 79. [Drawing 8](#) shows the block diagram of the desirable format for the message 90. Especially the message 90 includes the acknowledgement block 92 which reports that the network 10 received the front current position message 80 (see [drawing 7](#)) in the mobile unit 16. The message 90 contains the boundary layer data 94 in which the boundary line 22 (see [drawing 1](#)) is shown. The boundary layer data 94 should be constituted so that the boundary line 22 acquired as a result may

surround the current position pinpointed with the present position data 86 (see drawing 7) of the message 80.

[0031]After the message 90 is received, the task 96 (see drawing 6) saves the boundary layer data 94 (see drawing 8) to the data element 77 (see drawing 5) of the position table 54. The task 96 updates the time stamp-data element 98 of the position table 94, displays the present time, and updates the original position data element 79 (see drawing 5) of the position table 54, and displays a current position. Programmed control leaves Procedure 66 after the task 96. Procedure 66 is repeated according to the schedule after that.

[0032]If it returns to the task 78, when there is no current position of the mobile unit 16 in the outside of the boundary line 22, a different processing result will arise. Especially the procedure 66 investigates other conditions which can carry out the trigger of the transmission of the current position message to the network 10. Generally, in the usual operation, other conditions of these are backup conditions which are not produced rash. Therefore, when dealing with a report of the position generated as a result of these conditions, it is [that very little communication resources are only consumed and].

[0033]In particular, in desirable working example, it asks and it is judged whether as the current position of the mobile unit 16 was shown by the data element 79 (see drawing 5), only a predetermined distance exceeded the **** task 100 from the original position. Preferably, this predetermined distance is set to the big value like [it does not exceed it], unless a certain problem is encountered when the mobile unit 16 specifies the boundary line 22. If this predetermined distance is exceeded, the tasks 79, 88, and 96 are performed, and the network 10 is updated, and the new regulation over the boundary line 22 is received.

[0034]If this predetermined distance is not exceeded, the task 102 judges whether as compared with the present time, the predetermined period passed the time stamp (see drawing 5) recorded on the data element 98. This period is set to a very big value like [in January] 1 time, and when the mobile unit 16 which is in a state of rest comparatively by that cause reports those positions to the network 10, it is made to have most quantity of a communication resource consumed preferably. If this predetermined period does not exceed, the task 104 makes it make it Procedure 66 leave programmed control. On the other hand, if this predetermined period has passed, the task 104 will lead programmed control to the tasks 79, 88, and 96, in order to update the network 10.

[0035]If it returns to the task 52 (see drawing 4), the initialization of the position table 54 (see drawing 5) can set the time stamp-data element 98 to the predetermined value showing the day of the far past. Therefore, Procedure 66 is performed after energization, first, the task 104 detects a big period, a current position message is transmitted to the network 10, the original position and time stamp will be updated, and new boundary layer data will be received from the network 10.

[0036]Although Procedure 66 is repeated to a desirable regular schedule, the mobile unit 16 can receive a current position command message from the network 10 at arbitrary time, as shown in the node 106. It is ordered a current position command message so that it may answer by transmitting the data which shows the position of opposite *Perilla frutescens* (L.) Britton var. *crispa* (Thunb.) Decne. to the mobile unit 16. If this command is received, whether or not Procedure 66 will be active, the tasks 79, 88, and 96 will be performed. As stated above, in the tasks 79, 88, and 96, the mobile unit 16 transmits a current position message, and expects boundary layer data according to it.

[0037]Although the gateway 14 performs the pursuit function for the network 10 desirably, this pursuit function can also be performed in other parts of the network 10. Each gateway 14 performs this function to the mobile unit 16 registered there. In desirable working example, although each mobile unit 16 has the home (home) gateway 14, it is movable into the field served by other arbitrary gateways 14. The gateway 14 and the home gate way 14 which have been served can communicate mutually if needed, in order to share the information about the member mobile unit 16 through the network 10 or PSTN mutually. Drawing 9 shows the flow chart of the procedure performed when maintaining position data by the served gateway 14 for those registered mobile units 16. If it sees from the gateway 14, the current position message 80 (see drawing 7) is receivable from the registered arbitrary mobile units 16 at arbitrary time, as shown in the node 108. When the message 80 is received, the task 110 obtains the present position data 86 (see drawing 7) from the message 80.

[0038]The task 112 saves the present position data 86 in the memory structure of the subscriber database 114 maintained in the memory 46 (see drawing 3). Drawing 10 shows the block diagram of the database 114. The database 114 includes the record 116 over each registered mobile unit 16. The data field [as opposed to ID of a mobile unit in each record 116] 118, the data field 120 to the telephone number of a mobile unit, the data field 122 to the original position of a mobile unit, the data field 124 for the time stamp relevant to the position of said origin, And other data elements 126 are included. Other data elements 126 show a related home or the gateway under service, a fee collection command, a service level identifier, and other arbitrary data required for operation of the network 10.

[0039]When drawing 9 - drawing 10 are referred to, the data field 122 of the original position shows the position known at the last of the related mobile unit 16. It is the data field 122 that the present position data 86 is stored. In other words, now, the current position is used as an original position. The task 128 saves the present time to the time stamp-data field 124.

[0040]Next, since boundary layer data is generated, the task 130 uses the position of the present/origin which just received from the mobile unit 16. In desirable working example, the task 130 generates this boundary layer data using the boundary layer database 132. Drawing 11 shows the block diagram of the memory structure of the boundary layer database 132

maintained in the memory 46 (see [drawing 3](#)). The boundary layer database 132 includes the record 134 which shows the section of the field which receives service by the gateway 14. Each section is characterized with the minimum latitude 136, the maximum latitude 138, the minimum longitude 140, and the maximum longitude 142. The database 132 includes many records 134 as it is required to express the field which receives service by the gateway 14. Although this field does not necessarily need to be so, it can be fitted to one or the territorial jurisdiction 18 (see [drawing 1](#)) beyond it. Each record 134 contains the boundary layer data 144. The boundary layer data 144 describes the boundary line 22 (see [drawing 1](#)) which should relate to the arbitrary mobile units 16 located in the section specified with related latitude and the longitude 136-142. As stated above, the boundary layer data 144 can express the distance which acts as a radius. Or the boundary layer data 144 can express latitude and longitude. In practice, latitude and the longitude 136-142 can be committed as the boundary layer data 144.

[0041]If [drawing 9](#) and [drawing 11](#) are referred to, the task 130 will perform table-look-up operation, in order to detect the record 134 shown with the position data just received from the mobile unit 16 in the database 132. In desirable working example, the task 130 only reads suitable boundary layer data from the data element 144 of the database 132. This boundary layer data is constituted so that the boundary line 22 surrounding the position shown with said position data may be specified. If said position data becomes the form of the Doppler parameter and the satellite parameter, for example, the task 130 will change such a parameter into latitude and longitude information, before performing a table look-up to the database 132.

[0042]After the task 130 obtains boundary layer data, the task 146 returns the boundary layer data response message 90 (see [drawing 8](#)) to the mobile unit 16. The gateway 14 and the network 10 have ended processing of the current position message received in the node 108 after the task 146.

[0043]The gateway 14 can perform the maintenance procedure 148, in order to guarantee that the position of the origin of it is still closer to a current position as much as possible. As shown in the task 150, Procedure 148 is performed only at the traffic (off-peak) time which separated from the peak preferably. If the communications traffic in the network 10 which in other words passed the gateway 14 is close to the peak capacity, Procedure 148 will be postponed behind. Thus, it is lost that the communication produced from performing Procedure 148 takes the communication resource which a member may need.

[0044]In the task 152, the member registered now when it has position data of the origin which the time stamp 124 of the record 116 in the subscriber database 114 (see [drawing 10](#)) was searched, and became old is looked for. The task 152 can search one the time stamp 124 indicates predetermined age to be at least about current time of the records 116. If old record is found, the task 154 will transmit to the mobile unit 16 in which the current position command

was shown, and will wait for a response from this mobile unit 16. If a response is received, it performs, as the tasks 110,112,128,130 and 146 stated above, and the original position and the time stamp-data elements 122 and 124 will be updated, and new boundary layer data will be returned to the mobile unit 16. After performing the task 146, the maintenance procedure 148 is repeatable about other old member records 116.

[0045]

[Effect of the Invention]In short, this invention provides above the tracking system which minimum-izes quantity of communication required in order to maintain effective position data. A mobile unit is dynamically programmed with boundary layer data, and this boundary layer data is separately adapted for the position of a mobile unit. Therefore, this invention can respond to the necessity for the various position reports imposed in it by various fields where the mobile unit can operate.

[0046]This invention was explained about desirable working example as mentioned above. However, the person skilled in the art will recognize that change and correction can be made in this desirable working example, without separating from the range of this invention. For example, although it is explained that desirable working example uses the GPS Satellite base positioning system for providing a position signal to the mobile unit 16, other positioning systems or methods can also be used. it is used here -- as -- a term "spotting (position location)" -- a satellite base -- be -- or a ground base -- be -- it thinks including other possible positioning means and methods to the person skilled in the art. LORAN is an example of the positioning system which already used the available ground as the base in many portions in the world. Other positioning means and methods are also known. Therefore, it is considered that it is contained within the limits of this invention by these clear to a person skilled in the art, other change, and correction.

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PRIOR ART

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[0003]Position data is extremely worthy for a communication network. A network enables it to draw communication with the most sufficient convenience through the node of this network getting to know the position of a mobile unit. It enables it to suit in a network the various rules and procedures which a network may be imposed with various political substance which operates in the territorial jurisdiction. For example, one territorial jurisdiction may permit network employment only in the frequency of the 1st group, and the territorial jurisdiction which adjoins on the other hand may permit network employment only within the frequency of the 2nd group. It may be applied to the communications service used with the mobile unit which operates in the territorial jurisdiction where different customs duties differ from a tax.

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EFFECT OF THE INVENTION

[Effect of the Invention] In short, this invention provides above the tracking system which minimum-izes quantity of communication required in order to maintain effective position data. A mobile unit is dynamically programmed with boundary layer data, and this boundary layer data is separately adapted for the position of a mobile unit. Therefore, this invention can respond to the necessity for the various position reports imposed in it by various fields where the mobile unit can operate.

[0046] This invention was explained about desirable working example as mentioned above. However, the person skilled in the art will recognize that change and correction can be made in this desirable working example, without separating from the range of this invention. For example, although it is explained that desirable working example uses the GPS Satellite base positioning system for providing a position signal to the mobile unit 16, other positioning systems or methods can also be used. it is used here -- as -- a term "spotting (position location)" -- a satellite base -- be -- or a ground base -- be -- it thinks including other possible positioning means and methods to the person skilled in the art. LORAN is an example of the positioning system which already used the available ground as the base in many portions in the world. Other positioning means and methods are also known. Therefore, it is considered that it is contained within the limits of this invention by these clear to a person skilled in the art, other change, and correction.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] It is clear that position data's it is better as it becomes more exact. More exact data enables it to check more the time of a network crossing to the territorial jurisdiction of one territorial jurisdiction to others [mobile unit] to fitness. However, the strong necessity of cost increasing generally in proportion to the accuracy of position data, keeping cost as low as possible, and keeping an income as high as possible exists. It is the quantity of the communication resource consumed when maintaining the important position data of the present [one] of cost especially. The resources which can be exploited since it is used by a communications service member and an income is generated decrease more, so that it will be carried out, if more resources are consumed when maintaining the present position data. A mobile unit often carries out battery operation, and communication of a superfluous quantity leads to excessive use of available battery electric power.

[0005] Therefore, it is the purpose of this invention to provide the improved tracking system, and it is an advantage.

[0006] It is other purposes of this invention to provide the tracking system which minimum-izes quantity of communication required in order to maintain effective data, and it is an advantage.

[0007] It is the purpose of further others of this invention to provide a programmable tracking system so that the necessity for various position reports that a mobile unit is imposed by various fields which operate in it can be suited, and it is an advantage.

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OPERATION

[Means for Solving the Problem and its Function]The above, other purposes, and an advantage of this invention are realized by a method of pursuing a mobile unit with one gestalt. In a mobile unit, this method requires reception of a data message which describes a boundary line. A mobile unit judges a time of next this mobile unit being in the outside of this boundary line. When this mobile unit is in the outside of a boundary line, this mobile unit transmits a current position message which describes a position of a mobile unit at that time.

[0009]The above, other purposes, and an advantage of this invention are attained by a method of pursuing a mobile unit with other gestalten. It is required that the method should receive the original position data from a mobile unit. Data of a position of these origin describes the original position of this mobile unit. Data of the original position of these is saved and a data message is transmitted to this mobile unit. This data message describes a boundary line surrounding a position of said origin.

[Translation done.]

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EXAMPLE

[Example] Being able to acquire a more perfect understanding of this invention by referring to the following detailed explanation and Claim with Drawings, in Drawings, the same reference number shows the same item over each figure.

[0011] Drawing 1 shows one of many of the different fields of the earth where the communication network 10 operates. In desirable working example, the network 10 contains the artificial satellite 12 which goes the orbit of the earth around. The satellite 12 may be moving about the earth, may be standing it still (that is, it is in a geostationary orbit), or may contain some each. It thinks including such all the composition [term / which is used here / "an orbit is gone around" (orbit)] "goes an earth orbit around" (orbit the earth) again.

Communication can be drawn through the gateway 14 through the satellite 12. The gateway 14 is arranged as an institution fixed on the ground. The satellite 12 and the gateway 14 act as the node (node) for the network 10. the arbitrary terminals in which the gateway 14 was connected to the public exchange telecommunications network (PSTN), and communication was combined with PSTN by it through the network 10 -- or it enables it to lead from the arbitrary terminals combined with PSTN

[0012] The network 10 provides communications service to arbitrary numbers of mobile units 16. As the name shows, the mobile unit 16 is movable to one of specific positions from not a thing but a place for exclusive use in a place. The mobile unit 16 contains the device which can be easily conveyed barely with portable stock molding equipment. The mobile unit 16 establishes the neighboring satellite 12 and data communication link, and this satellite 12 relays the data communications to the neighboring gateway 14 next.

[0013] The mobile unit 16 operates in the arbitrary things of much different political or political territorial jurisdiction 18. The territorial jurisdiction 18 is surrounded by the political or political boundary line 20. Generally, the boundary line 20 has irregular shape. The network 10 gets to know when the mobile unit 16 went across the boundary line 20, and frequency assignment,

fee collection, a tax, and other parameters need to enable it to set it up according to the suitable territorial jurisdiction 18 by it. It gets to know where even if the network 10 is compared again and is not so exact, the mobile unit 16 is, and a call needs to be made to draw by it the best through the satellite 12.

[0014]As shown the mobile unit 16 by the mobile unit 16a, when it is located in the territorial jurisdiction 18, it is not close to the boundary line 20. As a result, it is only that the network 10 needs the comparatively inaccurate data about the position of the mobile unit 16a. The mobile unit 16a may move a comparatively big distance, before it approaches the boundary line 20. This big distance is shown by the radius of the surrounding circle of the mobile unit 16a. This circle forms the boundary line 22a.

[0015]On the other hand, as the mobile unit 16 is shown by the mobile unit 16b, when it is near the boundary line 20, the network 10 needs the comparatively exact data about the position of the mobile unit 16b. The mobile unit 16b can go into other territorial jurisdiction 18 by moving a comparatively small distance so that it may be shown by the radius of the boundary line 22b.

[0016]The mobile unit 16 determines the position of these selves selectively at least so that it may explain in detail by the following. In desirable working example of this invention, when the mobile unit 16 makes this decision, it uses the global positioning system 24 like Global Positioning System (GPS). The system 24 includes the group of the artificial satellite which turns around the orbit of the earth. The satellite of the system 24 may be the same as the satellite 12, or may differ. This is not an indispensable thing although the satellite of the system 24 differs from the satellite 12 in typical working example. Traditional art is used in order that the mobile unit 16 may supervise and process the signal transmitted by the system 24 in order to determine the position of these very thing. Although it is on account of explanation and this invention is not limited, and operation of the system 24 is described to the GPS position arrangement system, the person skilled in the art will understand that other spotting systems can be used.

[0017]In a general expression, the tracking system of this invention uses the gateway 14 of the mobile unit 16 and the network 10. The satellite 12 operates as a node for relaying the data communications between the mobile unit 16 and the gateway 14. In order that each mobile unit 16 may determine the position of itself and may tell the network 10 about the position, in the nearby "local" gateway 14, it transmits data communications to the network 10. When the gateway 14 receives the position communication, it generates the data which specifies the boundary line 22, and returns these boundary layer data to the mobile unit 16. As long as it is operating within the boundary line 22 as which the mobile unit 16 was specified, it does not need to notify the whereabouts to the network 10. However, when the mobile unit 16 moves to the outside of the boundary line 22, it transmits new position communication to the network 10, and receives new boundary layer regulation according to it.

[0018]Therefore, the tracking system of this invention makes the minimum the number of communication messages required in order to maintain an effective value. As shown by the mobile unit 16a and the boundary line 22a, when the data which is not so exact is permitted, the low data of correctness is maintained by some position communication messages. More exact data is maintained by more position communication messages when more exact data is required, as drawing 1 is shown by the mobile unit 16b and the boundary line 22b.

[0019]Drawing 2 shows the block diagram of the mobile unit 16. The mobile unit 16 contains the transmitter-receiver 26 which transmits a signal and is received in the format which is compatible with the satellite 12 and the network 10 (see drawing 1). These signals contain the data message which can be made to carry out the data communications of the mobile unit 16 with the neighboring satellite 12. The data communications of the mobile unit 16 can be carried out to other arbitrary nodes of the network 10 like the neighboring gateway 14 (see drawing 1) via this satellite 12 again. For example, the receiver 28 for spotting of the mobile unit 16 like a GPS receiver generates the data which receives the signal broadcast by the positioning system 24 (see drawing 1) and in which the current position of the mobile unit 16 is shown. Both the transmitter-receiver 26 and the receiver 28 are combined with the processor 30. The processor 30 is further combined with input/output (I/O) section 32, the timer 34, and the memory 36. The I/O section 32 is used in order to collect user inputs like operation of an electric power switch, and in order to collect the telephone numbers for setting up a call. The processor 30 uses the timer 34, in order to maintain the present time. The memory 36 contains in the mobile unit 16 the data which performs the procedure of explaining below, when the processor 30 performs including the data which acts as a command to the processor 30. The memory 36 contains the variable, table, and database which are operated by operation of the mobile unit 16.

[0020]Drawing 3 shows the block diagram of the gateway 14. The gateway 14 contains the transmitter-receiver 38 which transmits a signal and is received in the format which is compatible with the satellite 12 (see drawing 1). these signals -- the gateway 14 -- the neighboring satellite 12 -- and arbitrary numbers of mobile units 16 and the data message which can be made to carry out data communications are included. The transmitter-receiver 38 is combined with the processor 40. The processor 40 is combined with the I/O section 42, the timer 44, the memory 46, and PSTN interface 48 again. The I/O section 42 receives an input from a keyboard and other input devices, and provides a display terminal, a printer, and other output units with data. The processor 40 uses the timer 44, in order to maintain the present time. The memory 46 contains the semiconductor for memorizing the data which makes the gateway 14 perform the procedure of explaining below, and the memory storage of magnetic and others, when it acts as a command to the processor 40 and the processor 40 performs. The memory 46 contains the variable, table, and database which are operated by operation of

the gateway 14. The gateway 14 communicates with PSTN with the interface 48.

[0021]Drawing 4 shows the flow chart of the power up procedure 50 performed with the mobile unit 16 according to this invention. Procedure 50 is performed always, when the mobile unit 16 is energized. The task 52 performs initialization in the mobile unit 16. The person skilled in the art will understand between initialization that many memory locations can set it as a predetermined value. As shown in drawing 5, the position table 54 is memory structure which the mobile unit 16 maintains in the memory 36 (see drawing 2). The table 54 contains the data element explained in detail by the back. If it returns to drawing 4, the task 52 will set at least one of these data elements to a predetermined value. As soon as the positioning procedure of explaining below with reference to drawing 6 evaluates the data element by which it was initialized, a value predetermined [this] is chosen so that it may determine that it is required to transmit a position communication message to the gateway 14. As a result, the mobile unit 16 makes a position communication message the task 52 transmit to the gateway 14 according to energization of the mobile unit 16.

[0022]The task 56 synchronizes the transmitter-receiver 26 after the task 52 for communication with the neighboring satellite 12. The mobile unit 16 can be engaged in data communications with the network 10 after the task 56. The mobile unit 16 is registered into the network 10 in the task 58. This registration is attained by suiting a certain intrinsic proof (authentication) procedure which transmits to the gateway 14 which has served identification data, and is imposed by the network 10. The served gateway 14 is determined by the neighboring satellite 12 in the beginning in the process which is not in sight of the mobile unit 16 and the both sides of the gateway 14 which have given their service. The mobile unit 16 is ready to transmit a call or receive after registration. While standing by the user input which the mobile unit 16 enters and orders it a call or an outgoing call, it operates by the standby mode 60. When a call occurs from the standby mode 60, it can go into the call-processing mode 62, and can return from this mode. When power down of the mobile unit 16 is carried out, it goes into the power down mode 64. When it is energized, the mobile unit 16 leaves the power down mode 64, and repeats the power up procedure 50.

[0023]Drawing 6 shows the flow chart of the positioning procedure 66. The mobile unit 16 carries out repeat execution of Procedure 66 to a regular schedule, while it is operating in either the standby mode 60 or the call-processing mode 62 (see drawing 4). In desirable working example, this regular schedule may change from 1 degree to several minutes or 1 degree per several hours every several seconds.

[0024]It is judged whether between Procedures 66, the mobile unit 16 can be used in order to use it when the inquiry task 68 is performed and the signal from the positioning system 24 (see drawing 1) determines the position. In the usual operation, the system 24 is available and is the desirable art for determining a position. Therefore, when the system 24 is available, the

mobile unit 16 performs the task 70 using the spotting receiver 28 (see [drawing 2](#)), and receives the signal from the system 24. The task 70 obtains 1 set of parameters which process the signal with a traditional form and show a current position.

[0025]On the other hand, in order that the network 10 may prevent that it is thoroughly dependent on the system 24, this invention includes the backup technique for determining a current position. Therefore, when the system 24 cannot be used, a current position is determined from the signal which the task 72 is performed and is transmitted by the satellite 12 of the network 10. In desirable working example, the satellite 12 operates around those orbits in o'clock in about 25,000 km /about the earth. Therefore, the signal of these satellites receives the Doppler (Doppler) shift of most quantity, and this Doppler shift changes, when a satellite passes along overhead location. The satellite 12 transmits the position data of a cell. As a result, when combined with the position data of a cell, the task 72 supervises the range (range) and range rate (range rate) data, in order to obtain the Doppler sign (Doppler signature) corresponding to the position of the mobile unit 16. The backup technique whose intention it has in the task 72 may be a low speed, and may be lower than the spotting art of the task 70. [of accuracy] Nevertheless, such backup position data is more preferred than there is also no position data.

[0026]After the current position of the mobile unit 16 is determined in either of the task 70 or 72, the task 74 saves the present position data, and evaluates the current position about the present boundary layer 22a-22b (see [drawing 1](#)) established to the mobile unit 16. When it returns to [drawing 5](#), the position table 54 contains the data elements 76 and 77 used, respectively in order to memorize present position data and boundary layer data.

[0027]In order that the task 70 may determine a current position, when it is used, present position data shows latitude and longitude preferably. A term "latitude (latitude)" and "longitude (longitude)" are considered including other arbitrary standards or measuring technique which can identify a position as used here. In one working example of this invention, boundary layer data shows the minimum and maximum latitude and longitude. Therefore, it is convenient that the boundary line 22 is a quadrangle or a rectangle. It is judged whether the task 74 has a current position in the outside of the boundary line 22 in a current position as compared with the boundary line 22.

[0028]In another working example of this invention, boundary layer data shows the distance interpreted as a radius (radius). The data element 79 of the position table 54 (see [drawing 5](#)) shows the original latitude and longitude of the position. It is investigated whether the task 74 is in a big distance from the original position rather than some compare that current position and the mobile unit 16 is indicated to be with this radius. In this working example, the boundary line 22 forms the circle which has a radius which has a center in the original position and is specified with boundary layer data, as shown in [drawing 1](#). It is judged whether the task 74 has

the mobile unit 16 in the outside of the boundary line 22 again. Boundary layer data is not limited to what shows a quadrangle, a rectangle, or a circle, but the person skilled in the art will understand that the arbitrary shape containing the shape of the political territorial jurisdiction 18 can be shown.

[0029]After the task 74, if the inquiry task 78 has a current position of the mobile unit 16 in the outside of the boundary line 22, it will lead programmed control to the task 79. The task 79 transmits the data message 80 of a current position to the network 10. Drawing 7 shows the block diagram of the desirable format for the message 80. Especially the message 80 to the header 82 for notifying the network 10 that it is a current position message, and the network 10. The present position data 86 in which ID84 for reporting which mobile unit 16 has transmitted the message and the current position of the mobile unit 16 are shown by latitude/longitude or other parameter forms is included.

[0030]If it returns to drawing 6, Procedure 66 will stand by until the task 88 receives the response message 90 from the network 10 after the task 79. Drawing 8 shows the block diagram of the desirable format for the message 90. Especially the message 90 includes the acknowledgement block 92 which reports that the network 10 received the front current position message 80 (see drawing 7) in the mobile unit 16. The message 90 contains the boundary layer data 94 in which the boundary line 22 (see drawing 1) is shown. The boundary layer data 94 should be constituted so that the boundary line 22 acquired as a result may surround the current position pinpointed with the present position data 86 (see drawing 7) of the message 80.

[0031]After the message 90 is received, the task 96 (see drawing 6) saves the boundary layer data 94 (see drawing 8) to the data element 77 (see drawing 5) of the position table 54. The task 96 updates the time stamp-data element 98 of the position table 94, displays the present time, and updates the original position data element 79 (see drawing 5) of the position table 54, and displays a current position. Programmed control leaves Procedure 66 after the task 96. Procedure 66 is repeated according to the schedule after that.

[0032]If it returns to the task 78, when there is no current position of the mobile unit 16 in the outside of the boundary line 22, a different processing result will arise. Especially the procedure 66 investigates other conditions which can carry out the trigger of the transmission of the current position message to the network 10. Generally, in the usual operation, other conditions of these are backup conditions which are not produced rash. Therefore, when dealing with a report of the position generated as a result of these conditions, it is [that very little communication resources are only consumed and].

[0033]In particular, in desirable working example, it asks and it is judged whether as the current position of the mobile unit 16 was shown by the data element 79 (see drawing 5), only a predetermined distance exceeded the **** task 100 from the original position. Preferably, this

predetermined distance is set to the big value like [it does not exceed it], unless a certain problem is encountered when the mobile unit 16 specifies the boundary line 22. If this predetermined distance is exceeded, the tasks 79, 88, and 96 are performed, and the network 10 is updated, and the new regulation over the boundary line 22 is received.

[0034]If this predetermined distance is not exceeded, the task 102 judges whether as compared with the present time, the predetermined period passed the time stamp (see [drawing 5](#)) recorded on the data element 98. This period is set to a very big value like [in January] 1 time, and when the mobile unit 16 which is in a state of rest comparatively by that cause reports those positions to the network 10, it is made to have most quantity of a communication resource consumed preferably. If this predetermined period does not exceed, the task 104 makes it make it Procedure 66 leave programmed control. On the other hand, if this predetermined period has passed, the task 104 will lead programmed control to the tasks 79, 88, and 96, in order to update the network 10.

[0035]If it returns to the task 52 (see [drawing 4](#)), the initialization of the position table 54 (see [drawing 5](#)) can set the time stamp-data element 98 to the predetermined value showing the day of the far past. Therefore, Procedure 66 is performed after energization, first, the task 104 detects a big period, a current position message is transmitted to the network 10, the original position and time stamp will be updated, and new boundary layer data will be received from the network 10.

[0036]Although Procedure 66 is repeated to a desirable regular schedule, the mobile unit 16 can receive a current position command message from the network 10 at arbitrary time, as shown in the node 106. It is ordered a current position command message so that it may answer by transmitting the data which shows the position of opposite *Perilla frutescens* (L.) Britton var. *crispa* (Thunb.) Decne. to the mobile unit 16. If this command is received, whether or not Procedure 66 will be active, the tasks 79, 88, and 96 will be performed. As stated above, in the tasks 79, 88, and 96, the mobile unit 16 transmits a current position message, and expects boundary layer data according to it.

[0037]Although the gateway 14 performs the pursuit function for the network 10 desirably, this pursuit function can also be performed in other parts of the network 10. Each gateway 14 performs this function to the mobile unit 16 registered there. In desirable working example, although each mobile unit 16 has the home (home) gateway 14, it is movable into the field served by other arbitrary gateways 14. The gateway 14 and the home gate way 14 which have been served can communicate mutually if needed, in order to share the information about the member mobile unit 16 through the network 10 or PSTN mutually. [Drawing 9](#) shows the flow chart of the procedure performed when maintaining position data by the served gateway 14 for those registered mobile units 16. If it sees from the gateway 14, the current position message 80 (see [drawing 7](#)) is receivable from the registered arbitrary mobile units 16 at arbitrary time,

as shown in the node 108. When the message 80 is received, the task 110 obtains the present position data 86 (see [drawing 7](#)) from the message 80.

[0038]The task 112 saves the present position data 86 in the memory structure of the subscriber database 114 maintained in the memory 46 (see [drawing 3](#)). [Drawing 10](#) shows the block diagram of the database 114. The database 114 includes the record 116 over each registered mobile unit 16. The data field [as opposed to ID of a mobile unit in each record 116] 118, the data field 120 to the telephone number of a mobile unit, the data field 122 to the original position of a mobile unit, the data field 124 for the time stamp relevant to the position of said origin, And other data elements 126 are included. Other data elements 126 show a related home or the gateway under service, a fee collection command, a service level identifier, and other arbitrary data required for operation of the network 10.

[0039]When [drawing 9](#) - [drawing 10](#) are referred to, the data field 122 of the original position shows the position known at the last of the related mobile unit 16. It is the data field 122 that the present position data 86 is stored. In other words, now, the current position is used as an original position. The task 128 saves the present time to the time stamp-data field 124.

[0040]Next, since boundary layer data is generated, the task 130 uses the position of the present/origin which just received from the mobile unit 16. In desirable working example, the task 130 generates this boundary layer data using the boundary layer database 132. [Drawing 11](#) shows the block diagram of the memory structure of the boundary layer database 132 maintained in the memory 46 (see [drawing 3](#)). The boundary layer database 132 includes the record 134 which shows the section of the field which receives service by the gateway 14. Each section is characterized with the minimum latitude 136, the maximum latitude 138, the minimum longitude 140, and the maximum longitude 142. The database 132 includes many records 134 as it is required to express the field which receives service by the gateway 14. Although this field does not necessarily need to be so, it can be fitted to one or the territorial jurisdiction 18 (see [drawing 1](#)) beyond it. Each record 134 contains the boundary layer data 144. The boundary layer data 144 describes the boundary line 22 (see [drawing 1](#)) which should relate to the arbitrary mobile units 16 located in the section specified with related latitude and the longitude 136-142. As stated above, the boundary layer data 144 can express the distance which acts as a radius. Or the boundary layer data 144 can express latitude and longitude. In practice, latitude and the longitude 136-142 can be committed as the boundary layer data 144.

[0041]If [drawing 9](#) and [drawing 11](#) are referred to, the task 130 will perform table-look-up operation, in order to detect the record 134 shown with the position data just received from the mobile unit 16 in the database 132. In desirable working example, the task 130 only reads suitable boundary layer data from the data element 144 of the database 132. This boundary layer data is constituted so that the boundary line 22 surrounding the position shown with said

position data may be specified. If said position data becomes the form of the Doppler parameter and the satellite parameter, for example, the task 130 will change such a parameter into latitude and longitude information, before performing a table look-up to the database 132. [0042]After the task 130 obtains boundary layer data, the task 146 returns the boundary layer data response message 90 (see [drawing 8](#)) to the mobile unit 16. The gateway 14 and the network 10 have ended processing of the current position message received in the node 108 after the task 146.

[0043]The gateway 14 can perform the maintenance procedure 148, in order to guarantee that the position of the origin of it is still closer to a current position as much as possible. As shown in the task 150, Procedure 148 is performed only at the traffic (off-peak) time which separated from the peak preferably. If the communications traffic in the network 10 which in other words passed the gateway 14 is close to the peak capacity, Procedure 148 will be postponed behind. Thus, it is lost that the communication produced from performing Procedure 148 takes the communication resource which a member may need.

[0044]In the task 152, the member registered now when it has position data of the origin which the time stamp 124 of the record 116 in the subscriber database 114 (see [drawing 10](#)) was searched, and became old is looked for. The task 152 can search one the time stamp 124 indicates predetermined age to be at least about current time of the records 116. If old record is found, the task 154 will transmit to the mobile unit 16 in which the current position command was shown, and will wait for a response from this mobile unit 16. If a response is received, it performs, as the tasks 110,112,128,130 and 146 stated above, and the original position and the time stamp-data elements 122 and 124 will be updated, and new boundary layer data will be returned to the mobile unit 16. After performing the task 146, the maintenance procedure 148 is repeatable about other old member records 116.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is an explanatory view showing in it the field of the earth where the communication network operates.

[Drawing 2] It is a block diagram showing the mobile unit which communicates with said network.

[Drawing 3] It is a block diagram showing the gateway which acts as a node in said network.

[Drawing 4] It is a flow chart which shows the power up procedure performed with said mobile unit.

[Drawing 5] It is a block diagram showing the position table memory structure maintained in said mobile unit.

[Drawing 6] It is a flow chart which shows the positioning procedure performed with said mobile unit.

[Drawing 7] It is a block diagram showing the current position data message transmitted with said mobile unit.

[Drawing 8] It is a block diagram showing the boundary layer data message transmitted by said gateway.

[Drawing 9] It is a flow chart which shows the procedure performed by said gateway.

[Drawing 10] It is a block diagram showing the member data base memory structure maintained in said gateway.

[Drawing 11] It is a block diagram showing the boundary layer data base memory structure maintained in said gateway.

[Description of Notations]

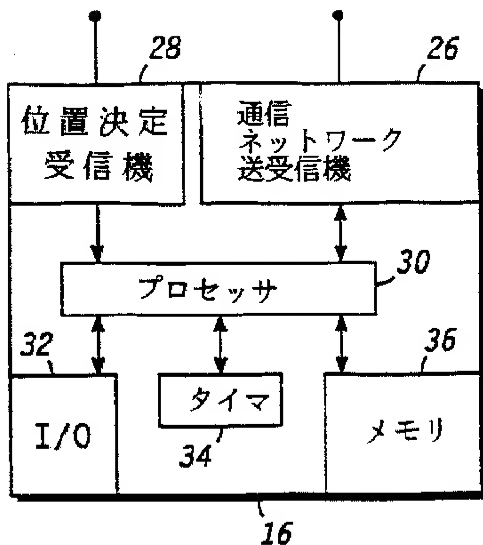
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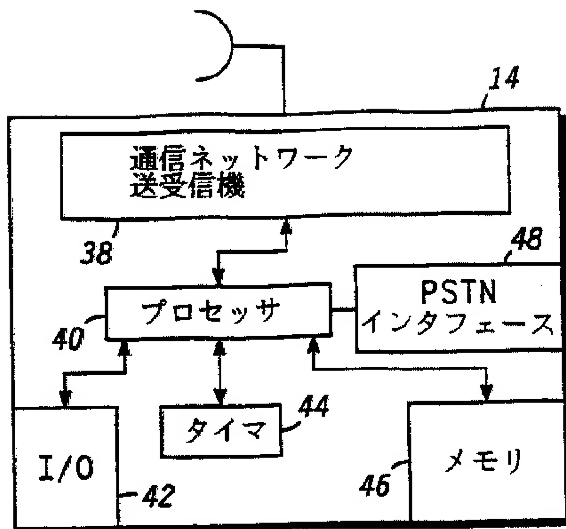
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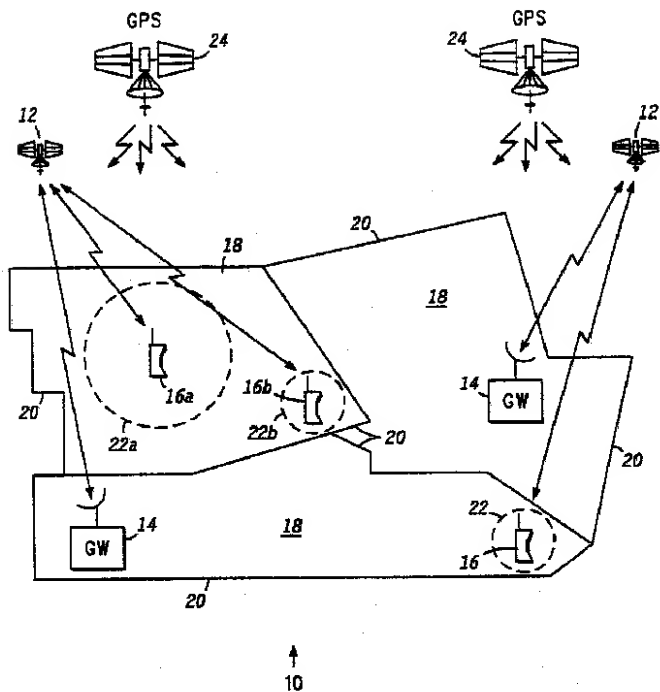
14 Gateway

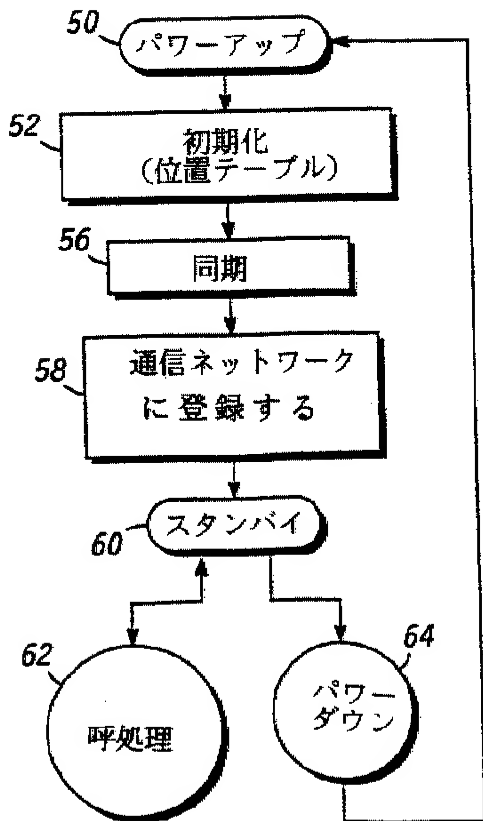
16 Mobile unit
18 Political territorial jurisdiction
20 and 22 Boundary line
24 Global positioning system
26 Transmitter-receiver
28 Receiver
30 Processor
32 and 42 Input/output (I/O) section
34 and 44 Timer
36 and 46 Memory
38 Transmitter-receiver
40 Processor
48 PSTN interface

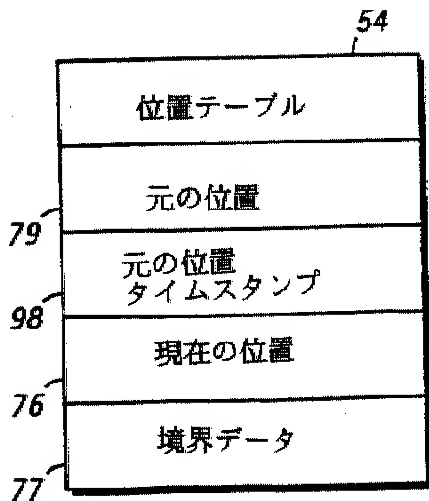
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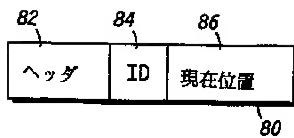


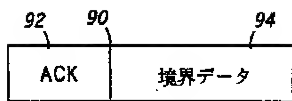












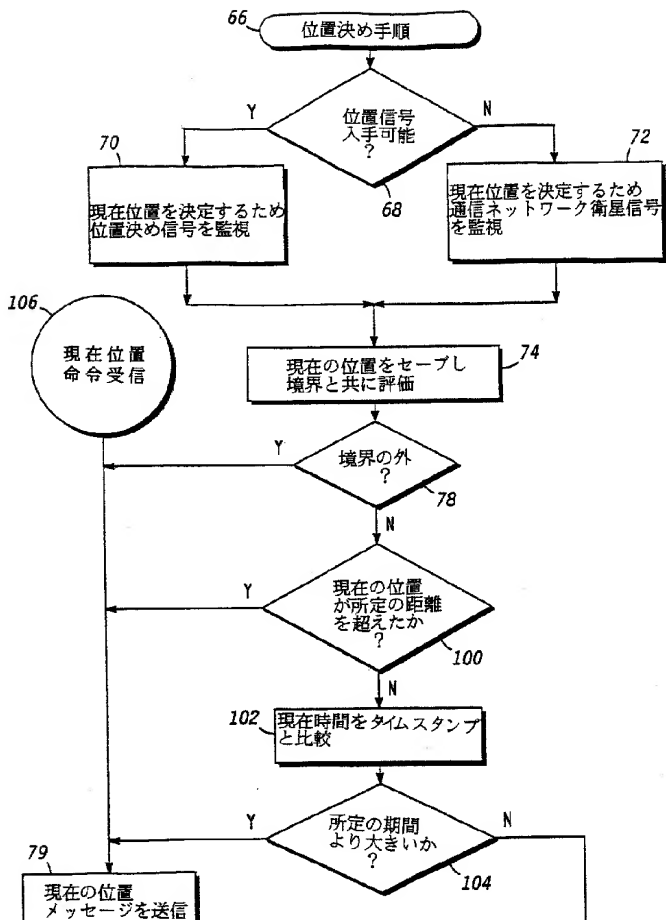
加入者データベース				
ID	電話番号	元の位置	位置 タイムスタンプ	その他
— — — ⋮ —	— — — ⋮ —	— — — ⋮ —	— — — ⋮ —	— — — ⋮ —

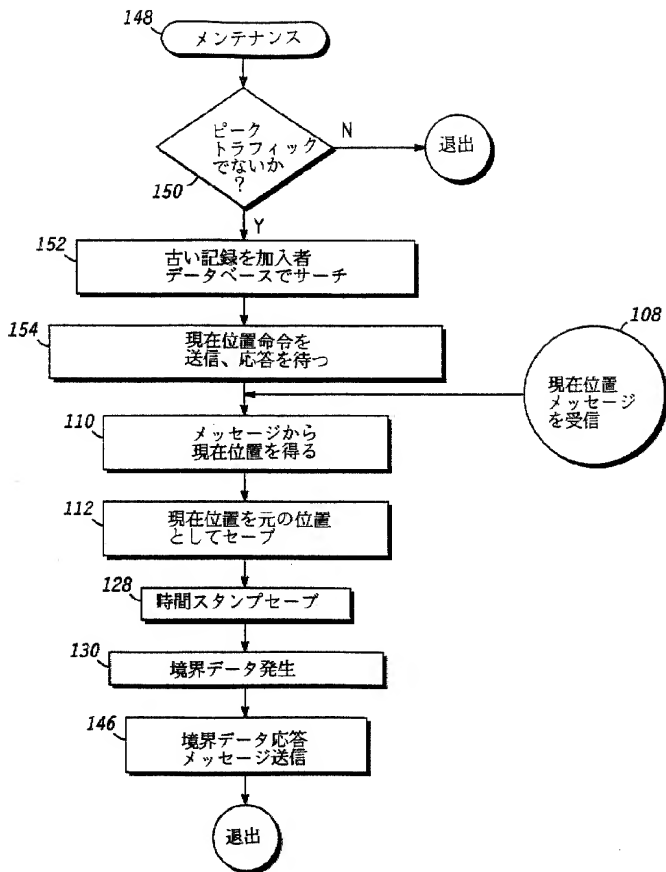
114

116

118 120 122 124 126

境界データベース				
MIN LAT.	MIN LAT.	MIN LONG.	MAX LONG.	境界 データ
— — — ⋮ —	— — — ⋮ —	— — — ⋮ —	— — — ⋮ —	— — — ⋮ —
136	138	140	142	144





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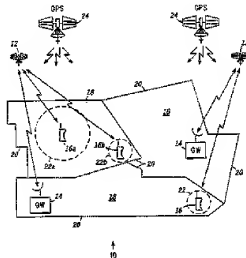
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(54)【発明の名称】 移動ユニット追跡システム

(57)【要約】

【目的】 有効な位置データを維持するために必要な通信量を最少化した追跡システムを提供する。

【構成】 通信ネットワーク(10)はそれを利用する移動ユニット(16)の位置を追跡する。パワーアップにより、移動ユニットは例えば5画上の衛星(12、24)により送信される信号を用いてそれらの現在位置を決定する。次に該位置を示すデータ通信メッセージ(80)をネットワークに送信する。ネットワークは該位置(122)を保存しかつ該移動ユニットの位置を囲む境界線(22)を示すデータメッセージ(90)を送送する。移動ユニットは定期的に現在位置を繰り返し判定する。現在位置が予め規定された境界線の外にあれば、他の位置データメッセージ(80)をネットワークに送信してネットワークによって維持される位置データを更新しかつ新しい境界線(22)の構成を受信する。



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【特許請求の範囲】

【請求項1】 移動ユニットを追跡する方法であって、
該方法は、

前記移動ユニット（16）において、境界線を示すデータメッセージ（94）を受信する段階、

前記移動ユニット（16）において、前記移動ユニットが前記境界線の外側にある場合を判定する段階（78）、そして前記移動ユニットが前記境界線の外側にある場合に、前記移動ユニット（16）から前記移動ユニット（16）の現在位置を示す現在位置データメッセージ（86）を送信する段階（79）、

を具備することを特徴とする移動ユニットを追跡する方法。
【請求項2】 移動ユニット（16）を追跡する方法であって、該方法は、

前記移動ユニット（16）において、元の位置データ（74）を発生する段階であって、前記元の位置データは前記移動ユニットの元の位置を示すもの、

前記移動ユニットから、前記元の位置を示すデータメッセージを送信する段階（79）、そして前記移動ユニットにおいて、境界線を示すデータメッセージ（94）を受信する段階（88）、

を具備することを特徴とする移動ユニット（16）を追跡する方法。
【請求項3】 移動ユニット（16）を追跡する方法であって、該方法は、

前記移動ユニット（16）から元の位置データを受信する段階（111）であって、前記元の位置データ（79）は前記移動ユニット（16）の元の位置を示すもの、

前記元の位置データを保存する段階（112）、そしてデータメッセージを前記移動ユニット（16）に送信する段階（146）であって、前記データメッセージは前記元の位置を囲む境界線を示すもの、

を具備することを特徴とする移動ユニット（16）を追跡する方法。
【請求項4】 移動ユニットに対する位置を示すデータを管理するシステムにおいて使用するための該移動ユニット（16）であって、前記システムが、

位置発生器（28）、メモリ（36）、

送受信機（26）、そして前記位置発生器、前記メモリ、および前記送受信機に結合され、前記位置発生器から元の位置データを、前記メモリに前記元の位置データを保存させ、かつ前記送受信機に前記元の位置データを通信させるよう構成されているプロセッサ（30）、を具備することを特徴とする移動ユニット（16）。
【請求項5】 制御ユニット（14）と移動ユニット（16）との間で通信される追跡データを追跡データ通信が最少化されるように管理するためのシステムであっ

て、該システムは、

移動ユニット位置発生器（28）、

移動ユニットメモリ（36）、

移動ユニット送受信機（26）、

前記位置発生器、前記移動ユニットメモリ、および前記移動ユニット送受信機に結合された移動ユニットプロセッサ（30）、

前記移動ユニット送受信機（26）とデータ通信する制御ユニット送受信機（38）、

制御ユニットメモリ（46）、そして前記制御ユニット送受信機（38）および前記制御ユニットメモリ（46）に結合された制御ユニットプロセッサ（40）、

を具備することを特徴とする制御ユニット（14）と移動ユニット（16）との間で通信される追跡データを管理するためのシステム。
【発明の詳細な説明】
【0001】
【産業上の利用分野】本発明は一般的には追跡システム（tracking systems）に関する。より詳細には、本発明は移動ユニットの位置を示すデータを維持する追跡システムに関する。
【0002】
【従来の技術】追跡システムは時々移動ユニットの所在を発見するために無線通信を使用する。そのような追跡システムの1つの例は移動無線送受信機によって通信サービスを提供する通信ネットワークによって使用される。無線機ユーザに見えない（transparent）、無線通信メッセージは中央コントロールに該ネットワークによって通信サービスを受けている移動送受信機の位置を通知し続ける。
【0003】位置データは通信ネットワークにとって極めて価値があるものである。移動ユニットの位置を知ることばネットワークが該ネットワークのノードを遍して最も都合よく通信を導くことができるようになる。さらに、それはネットワークがその管轄区内で動作する様々な政治的な実体によって課せられる種々の規則および手順にネットワークが適合できるようにする。例えば、1つの管轄区はネットワークの運用を単一の組の施設敷内にのみ許す。一方隣接する管轄区はネットワークの運用を第2の組の施設敷内でのみ許容できるようにする。さらに、異なる管轄区または租税が異なる管轄区で動作する移動ユニットによって使用される通信サービスに対して適用されるかも知れない。
【0004】
【発明が解決しようとする課題】位置データはより正確になればなるほど良いことは明らかである。より正確なデータはネットワークが移動ユニットが1つの管轄区から他の管轄区に渡った時をより良好に認識できるようにする。しかしながら、位置データの正確さに比例して一般にコストが増大し、かつコストをできるだけ低く保ち

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かつ収入をできるだけ高く保つ強い必要性が存在する。特に重要な、コストの1つは現在の位置データを維持する上で消費される通信資源の量である。現在の位置データを維持する上でより多くの資源が消費されればされるほど、通信サービス加入者によって使用しかつ収入を生ずるために利用できる資源がより少なくなる。さらに、移動ユニットはしばしばバッテリー動作し、かつ追跡可能な通信は利用可能なバッテリー電力の余分な使用につながる。

【0005】従って、改良された追跡システムを提供するのが本発明の目的でありかつ利点である。

【0006】有効なデータを維持するために必要な通信の量を最小化する追跡システムを提供するのが本発明の他の目的でありかつ利点である。

【0007】移動ユニットがその中で動作する様々な領域によって隔まれる複数の位置報告の必要性に適合することができるようにプログラム可能な追跡システムを提供するのが本発明のさらに他の目的でありかつ利点である。

【0008】

【詳細を解決するための手段および作用】本発明の上記および他の目的および利点は1つの形態で移動ユニットを追跡する方法によって実現される。移動ユニットにおいて、本方法は境界線を記述するデータメッセージの受信を要求する。移動ユニットは次に該移動ユニットが境界線の外側にある時を判定する。該移動ユニットが境界線の外側にある時には、該移動ユニットはその時の移動ユニットの位置を記述する現在位置メッセージを送信する。

【0009】本発明の上記および他の目的および利点は他の形態で移動ユニットを追跡する方法によって達成される。その方法は移動ユニットから元の位置データを受信することを要求する。これらの元の位置のデータは該移動ユニットの元の位置を記述する。これらの元の位置のデータは保存され、かつデータメッセージが該移動ユニットに送信される。該データメッセージは前記元の位置を含む境界線を記述する。

【0010】

【実施例】本発明のより完全な理解は図面と共に以下の詳細な説明および請求の範囲を要することにより得ることができ、図面においては図1は参照数字と共にわたり同じ項目を示している。

【0011】図1は通信ネットワーク10が動作する地球の数の異なる領域の1つを示す。好ましい実施例においては、ネットワーク10は地球の軌道を周回する人工衛星12を含む。衛星12は地球に面して移動していても良く、あるいは静止していても良く（すなわち、地球静止軌道にある）、あるいはそれぞれを吸るか含むものでも良い。ここで用いられている、用語「軌道を周回する（orbit）」または「地球軌道を周回する（o-

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rbital the earth）」はすべてのそのような構成を含むものと考えている。通信衛星12を周回かつゲートウェイ14を通過して導くことができる。ゲートウェイ14は地上に固定された施設として配置される。衛星12およびゲートウェイ14はネットワーク10のためのノード（node）として作用する。ゲートウェイ14は公共交換電話通信ネットワーク（PSTN）に接続され、それによって通信がネットワーク10を通過してPSTNに結合された任意の端子にあるいはPSTNに結合された任意の端子から導くことができるようにする。

【0012】ネットワーク10は任意の数の移動ユニット16に対し通信サービスを提供する。その名前が示すように、移動ユニット16はいずれかの特定の位置に専用のものでなく、場所から場所へと移動できる。移動ユニット16は容易に携帯可能な手持ち型装置と共にかるうて輸送できる装置を含む。移動ユニット16は近隣の衛星12とデータ通信リンクを確立し、該衛星12は次にそのデータ通信を近隣のゲートウェイ14に中継する。

【0013】移動ユニット16は数多くの異なる政治的または政務的管轄区18の内の任意のものの中で動作する。管轄区18は政治的または政務的境界線20によって囲まれている。一般に、境界線20は不規則な形状を有する。ネットワーク10は移動ユニット16がいつ境界線20を渡ったかを知り、それによって国別数割当て、課金、税金、および他のパラメータが適切な管轄区18に従って設定できるようにする必要がある。ネットワーク10はまた例えばそれとは正確でなくとも、移動ユニット16がどこにあるかを知り、それによって呼が衛星12を通して最も良好に導かれるようにする必要がある。

【0014】移動ユニット16が、移動ユニット16aで示されるように、管轄区18内に位置する時、それは境界線20に近くはない。その結果、ネットワーク10は移動ユニット16aの位置に関する比較的正確なデータを必要とするのみである。移動ユニット16aはそれが境界線20に近づく前に比較的大きな距離を移動するかも知れない。この大きな距離は移動ユニット16aの周りの円の半径によって示されている。この円が境界線20aを形成する。

【0015】これに対し、移動ユニット16bが、移動ユニット16bで示されるように、境界線20の近くにある場合には、ネットワーク10は移動ユニット16bの位置に関する比較的正確なデータを必要とする。移動ユニット16bは境界線20bの半径によって示されるように、比較的小さな距離を移動することにより他の管轄区18に入ることができる。

【0016】以下により詳細に説明するように、移動ユニット16は、少なくとも部分的に、それら自身の位置

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を決定する。本発明の好ましい実施例においては、移動ユニット16は、この決定を行う上で、地球軌道システム(GPS)のような、衛星測位システム24を利用する。システム24は地球の軌道面を回る人工衛星の群を含む。システム24の衛星は衛星12と同じでもよくあるいは異なることも良い。典型的な実施例では、システム24の衛星は衛星12と異なるが、これは必須のことではない。移動ユニット16はそれら自身の位置を決定するためにシステム24によって送信される信号を監視し、かつ処理するために伝統的な技術を利用する。説明の部上であって本発明を限定するものではないが、システム24の動作はGPS位置決めシステムに対して述べられているが、当業者は他の位置決定システムも利用できることを理解するであろう。

[0017] 一般的な表現では、本発明の追跡システムは移動ユニット16およびネットワーク10のゲートウェイ14を使用する。衛星12は移動ユニット16とゲートウェイ14との間のデータ通信を中継するためのノードとして動作する。各移動ユニット16はそれ自身の位置を決定し、かつネットワーク10にその位置を知らせるため、近くの「ローカル」ゲートウェイ14においてネットワーク10にデータ通信を送信する。ゲートウェイ14がその位置通信を受信した時、それは境界線22を規定するデータを発生し、これらの境界線データを移動ユニット16に返送する。移動ユニット16が規定された境界線22内で動作している限り、それはネットワーク10にその存在を通知する必要はない。しかしながら、移動ユニット16が境界線22の外側に移動した時、それは新しい位置通信をネットワーク10に送信し、かつそれに応じて新しい境界線規定を受信する。

[0018] 従って、本発明の追跡システムは有効な値を維持するために必要な通信メッセージの数を最小にする。移動ユニット16および境界線22で示されるように、それほど正確でないデータが許容される場合には、少しの位置通信メッセージによって正確さの低いデータが維持される。図1において移動ユニット16および境界線22で示されるように、より正確なデータが要求される場合にはより多くの位置通信メッセージによってより正確なデータが維持される。

[0019] 図2は、移動ユニット16のブロック図を示す。移動ユニット16は衛星12およびネットワーク10(図1を参照)と両立するフォーマットで信号を送信し、かつ受信する送受信機26を含む。これらの信号は移動ユニット16が近隣の衛星12とデータ通信できるようにするデータメッセージを含む。この衛星12を介して移動ユニット16はまた、近隣のゲートウェイ14(図1を参照)のような、ネットワーク10の任意の他のノードとデータ通信することができる。例えば、GPS受信機のような、移動ユニット16の位置決定用受信機28は測位システム24(図1を参照)によって放送

される信号を受信し、かつ移動ユニット16の現在位置を示すデータが発生する。送受信機26および受信機28は共にプロセッサ30に結合されている。プロセッサ30はさらに入力/出力(I/O)セクション32、タイマ34、およびメモリ36に結合されている。I/Oセクション32は、電源スイッチの操作のような、ユーザ入力を集めるため、および時を設定するための電話番号の収集を行うために使用される。プロセッサ30は現在の日時を選択するためにタイマ34を使用する。メモリ36はプロセッサ30への命令として作用するデータを含む。かつ、プロセッサ30により実行された時、移動ユニット16に以下に説明する手順を実行させるデータを含む。さらに、メモリ36は移動ユニット16の動作によって操作される複数、テーブル、およびデータベースを含む。

[0020] 図3は、ゲートウェイ14のブロック図を示す。ゲートウェイ14は衛星12(図1を参照)と両立するフォーマットで信号を送信し、かつ受信する送受信機38を含む。これらの信号はゲートウェイ14が近隣の衛星12とデータ通信できるようにするデータメッセージを含む。送受信機38はプロセッサ40に結合されている。プロセッサ40はまたI/Oセクション42、タイマ44、メモリ46、およびPSTNインタフェース48に結合されている。I/Oセクション42はキーボードおよび他の入力装置から入力を受信し、かつデータを表示ターミナル、プリンタ、および他の出力装置に提供する。プロセッサ40は現在の日時を選択するためにタイマ44を使用する。メモリ46はプロセッサ40への命令として作用し、かつ、プロセッサ40によって実行された時、ゲートウェイ14に以下に説明する手順を実行させるデータを記憶するための半導体、磁気的、および他の記憶装置を含む。さらに、メモリ46はゲートウェイ14の動作によって操作される複数、テーブル、およびデータベースを含む。インタフェース48により、ゲートウェイ14はPSTNと通信する。

[0021] 図4は本発明に従って移動ユニット16によって行われるパワーアップ手順50のフローチャートを示す。手順50は移動ユニット16が付勢された時にはいつでも実行される。タスク52は移動ユニット16内の初期化を行う。当業者は初期化の間に数多くのメモリ位置が所定の値に設定できることを理解するであろう。図5に示されるように、位置テーブル54は移動ユニット16がメモリ36(図2を参照)内に保持するメモリ構造である。テーブル54は後により詳細に説明するデータエレメントを含む。図4に戻ると、タスク52はこれらのデータエレメントの内の少なくとも1つを所定の値にセットする。該所定の値は、図6を参照して以下に説明する。側面手順がそれが初期化されたデータエレメントを評価するや否や位置通信メッセージがゲート

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ウェイ14に送信されることを必要であることを決定するように選択される。その結果、タスク52は移動ユニット16が移動ユニット16の付勢に応じて位置通信メッセージをゲートウェイ14に送信するようにさせる。[0022] タスク52の後、タスク56は送受信機26を近隣の衛星12との通信のために同期させる。タスク56の後、移動ユニット16はネットワーク10とのデータ通信に従事することができる。タスク58においては、移動ユニット16はネットワーク10に登録する。この登録は識別データをサービスしているゲートウェイ14に送信しかつネットワーク10によって課される何らかの真正証明(authentication)手順に適合することによって達成される。サービスしているゲートウェイ14は始めは移動ユニット16およびサービスしているゲートウェイ14の双方に見えないプロセッサで近隣の衛星12によって決定される。登録の後、移動ユニット16は呼を送信あるいは受信する用意ができる。移動ユニット16が入り呼または出呼を指令するユーザ入力を持続している時は、それはスタンバイモード60で動作する。スタンバイモード60から呼が発生した時それは呼処理モード62に入りかつ該モードから戻ることができる。移動ユニット16がパワーダウンされた時、それはパワーダウンモード64に入る。移動ユニット16はそれが付勢された時パワーダウンモード64を退出してパワーアップ手順50を回復する。[0023] 図8は、測位手順66のプロチャートを示す。移動ユニット16はそれがスタンバイモード60あるいは呼処理モード62(図4を参照)のいずれかで動作している間に手順66を規則的なスケジュールで繰り返して実行する。好ましい実施例においては、この規則的なスケジュールは教団ごとに1度から数分または数時間ごとに1度に変化する。[0024] 手順66の間においては、移動ユニット16は問い合わせタスク68を実行して測位システム24(図1を参照)からの信号がその位置を決定する上で使用するために利用できるかを判定する。通常の動作においては、システム24は利用可能でありかつ位置を決定するための好ましい技術である。従って、システム24が利用可能である場合には、移動ユニット16は位置決定受信機28(図2を参照)を利用してタスク70を実行しシステム24からの信号を受信する。タスク70はその信号を伝統的な形式で処理して現在位置を示す1組のパラメータを得る。[0025] これに対し、ネットワーク10がシステム24に完全に依存することを防止するため、本発明は現在位置を決定するためのバックアップ技術を含む。従って、システム24が利用できない場合には、タスク72が実行されてネットワーク10の衛星12によって送信される信号から現在位置を決定する。好ましい実施例においては、衛星12は地球に周回するそれらの軌道を約2

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5,000 km/時で運行する。従って、これらの衛星の信号はかなりの量のドップラ(Doppler)シフトを帯び、このドップラシフトは衛星が周回する時に変化する。さらに、衛星12はセルの位置データを送信する。その結果、タスク72は、セルの位置データと組み合わされた時、移動ユニット16の位置に対応するドップラ記号(Doppler signature)を得るために範囲(range)および範囲レート(range rate)データを監視する。タスク72において意図されているバックアップ技術はタスク70の位置決定技術よりも低速でありかつ精度が低いから知れない。それにもかかわらず、そのようなバックアップ位置データは何らの位置データもないよりは好ましい。[0026] 移動ユニット16の現在位置がタスク76または72のいずれかにおいて決定された後、タスク74はその現在位置データを受けしかつその現在位置をその移動ユニット16に対して確立された現在の境界線22a-22b(図1を参照)に附して評価する。図5に示すように、位置データベース4は、それぞれ、現在位置データおよび境界線データを記憶するために使用されるデータエレメント76および77を含む。[0027] タスク70が現在位置を決定するために使用された場合には、現在位置データは好ましくは精度および経度を示す。ここで用いられているように、用語「緯度(latitude)」および「経度(longitude)」は位置を識別することができる任意の座標の基準または測定技術を含むものと考えている。本発明の1つの実施例においては、境界線データは最小および最大の緯度および経度を示している。従って、境界線22は四角形または長方形であるのが都合が良い。タスク74は現在位置を境界線22と比較して現在位置が境界線22の外側にあるかを判定する。[0028] 本発明の別の実施例においては、境界線データは半径(radius)と観察される距離を示す。位置データベース4(図5を参照)のデータエレメント79は元の位置の緯度および経度を示している。タスク74はその現在位置と比較して移動ユニット16がその半径によって示されるものよりも元の位置から大きな距離にあるかを否かを調べる。この実施例では、境界線22は、図1に示されるように、元の位置を中心に半径を有する円を形成する。タスク74は再び移動ユニット16が境界線22の外側にあるかを否かを判定する。当業者は境界線データは四角形、長方形、または円を示すものに限定されず、政策的な管轄区18の形状を含む任意の形状を示すことができることを理解することである。[0029] タスク74の後、問い合わせタスク78はもし移動ユニット16の現在位置が境界線22の外側にあればプログラム制御をタスク79に導く。タスク79は現在位置のデータメッセージ80をネットワーク10

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に送信する。図7はメッセージ80のための好ましいフォーマットのブロック図を示す。特に、メッセージ80はネットワーク10にそれら現在位置メッセージであることを通知するためのヘッダ82、ネットワーク10に、その移動ユニット16がメッセージを送信しているか、通知するためのID84、および移動ユニット16の現在位置を緯度/経度または他のパラメータ形式で示す現在位置データ86を含む。

[0030] 図8に示ると、手順66はタスク79の後にタスク88がネットワーク10から応答メッセージ90を受信するまで待機する。図8は、メッセージ90のための好ましいフォーマットのブロック図を示す。特に、メッセージ90は移動ユニット16にネットワーク10が現在の位置メッセージ80（図7を参照）を受信したことを通知するアクノビュメントブロック92を含む。さらに、メッセージ90は境界線22（図1を参照）を示す境界線データ94を含む。境界線データ94は結果として得られる境界線22がメッセージ80の現在位置データ86（図7を参照）によって特定される現在位置を囲むように構成されるべきである。

[0031] メッセージ90が受信された後、タスク96（図6を参照）は境界線データ94（図8を参照）を位置テーブル54のデータエレメント77（図5を参照）にセーブする。さらに、タスク96は位置テーブル94の時間スタンプデータエレメント98を更新して現在の日時を表示し、かつ位置テーブル54の元の位置データエレメント79（図5を参照）を更新して現在位置を表示する。タスク96の後、プログラム制御は手順66を退出する。手順66はその後のスケジュールに従って繰り返される。

[0032] タスク78に戻ると、移動ユニット16の現在位置が境界線22の外側にない場合には異なる処理結果が生ずる。特に、手順66はネットワーク10への現在位置メッセージの送信をトリガすることができる他の条件を調べ、一般に、これらの他の条件は通常の動作においては滅多に生じないバックアップ条件である。従って、これらの条件の結果として発生する位置の報告を取り扱う上で非常に少量の通信資源が消費されるものである。

[0033] 特に、好ましい実施例では図1に示したタスク100は移動ユニット16の現在位置が、データエレメント79（図5を参照）により示されるように、元の位置から所定の距離だけ離れたか否かを判定する。好ましくは、この所定の距離は移動ユニット16が境界線22を規定する上で何らかの問題に遭遇しない限りそれを越えることはありそうにないほどの大きな値にセットされる。もしこの所定の距離を超えたと、タスク79、88および96が行われてネットワーク10を更新し、かつ境界線22に対する新しい境界を受信する。

[0034] もしこの所定の距離を超えられなければ、

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タスク102はデータエレメント98に記録された時間スタンプ（図5を参照）を現在の日時と比較して所定の期間が経過したか否かを判定する。好ましくは、この期間は、1月に1度のような、非常に大きな値にセットされ、それにより比較的静止状態にある移動ユニット16がそれらの位置をネットワーク10に報告する上でかなりの量の通信資源を消費しないようにされる。もしこの所定の期間が経過してゐなければ、タスク104はプログラム制御を手順66を退出するようにさせる。これに対し、もしこの所定の期間が経過してゐれば、タスク104はネットワーク10を更新するためにプログラム制御をタスク79、88および96に導く。

[0035] タスク52（図4を参照）に戻ると、位置テーブル54（図5を参照）の初期化は時間スタンプデータエレメント98を正しい過去の日を表す所定の値にセットすることができる。従って、付随的に手順66が行われて最初に、タスク104は大きな期間を抽出し、現在位置メッセージがネットワーク10に送信され、元の位置および時間スタンプが更新され、かつ新しい境界線データがネットワーク10から受信されるであろう。

[0036] 手順66は好ましくは規則的なスケジュールで繰り返されるが、移動ユニット16は、ノード106に示されるように、ネットワーク10から現在位置命令メッセージを任意の時間を受信することができる。現在位置命令メッセージは移動ユニット16に対しその位置を示すデータを送信することにより応答するよう指令する。この命令が受信されると、手順66がアクティブであろうとならうとタスク79、88および96が行われる。上に述べたように、タスク79、88および96においては、移動ユニット16は現在位置メッセージを送信し、かつそれに依りて境界線データを期待する。

[0037] ゲートウェイ14は通常しくはネットワーク10のための追跡機能を行なうが、この追跡機能はネットワーク10の他の箇所で行なうこともできる。各ゲートウェイ14はそこに登録された移動ユニット16に対してこの機能を行なう。好ましい実施例においては、各移動ユニット16はホーム（home）ゲートウェイ14を有するが、任意の他のゲートウェイ14によってサービスされる領域内に移動することができる。サービスしているゲートウェイ14およびホームゲートウェイ14は互いにネットワーク10またはPSTNを通して加入者移動ユニット16に関する情報を共有するために必要に応じて互いに通信することができる。図9はサービスしているゲートウェイ14によってそれらの登録された移動ユニット16のために位置データを維持する上で行なわれる手順のフローチャートを示す。ゲートウェイ14から見ると、現在位置メッセージ80（図7を参照）は、ノード108に示されるように、任意の登録された移動ユニット16から任意の時間を受信することができ、メッセージ80が受信された時、タスク110

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はメッセージ8 0から現在位置データ8 6（図7を参照）を得る。

【0 0 3 8】タスク1 1 2は現在位置データ8 6をメモリ4 6（図3を参照）内に維持された加入者データベース1 1 4のメモリ構造の中にセーブする。図1 0はデータベース1 1 4のブロック図を示す。データベース1 1 4は各々の登録された移動ユニット1 6に対する記録1 1 6を含む。各々の記録1 1 6は移動ユニットのIDに対するデータフィールド1 1 8、移動ユニットの電話番号に対するデータフィールド1 2 0、移動ユニットの元の位置に対するデータフィールド1 2 2、前記元の位置に関連する時間スタンプのためのデータフィールド1 2 4、および他のデータエレメント1 2 6を含む。他のデータエレメント1 2 6は関連するホームまたはサービス中のゲートウェイ、資金命令、サービスレベル識別子、およびネットワーク1 0の動作にとって必要な任意の他のデータを示す。

【0 0 3 9】図9～図1 0を参照すると、元の位置のデータフィールド1 2 2は関連する移動ユニット1 6の最後に知られた位置を示す。現在位置データ8 6が格納されるのはデータフィールド1 2 2である。言い換えれば、その現在位置が今や元の位置として使用される。タスク1 2 8は時間スタンプデータフィールド1 2 4に現在の日時をセーブする。

【0 0 4 0】次に、タスク1 3 0は境界線データを発生するために移動ユニット1 6から受信したばかりの現在の元の位置を使用する。好ましい実施例においては、タスク1 3 0は境界線データベース1 3 2を使用して該境界線データを発生する。図1 1はメモリ4 6（図3を参照）内に維持される境界線データベース1 3 2のメモリ構造のブロック図を示す。境界線データベース1 3 2はゲートウェイ1 4によってサービスを受ける領域のセクションを示す記録1 3 4を含む。各セクションは最小緯度1 3 6、最大緯度1 3 8、最小経度1 4 0、および最大経度1 4 2によって特徴づけられる。データベース1 3 2はゲートウェイ1 4によってサービスを受ける領域を表現するために必要なだけ多くの記録1 3 4を含む。この領域は、必ずしもそうである必要はないが、一つまたはそれ以上の管理区1 8（図1を参照）に適合させることができる。各記録1 3 4は境界線データ1 4 4を含む。境界線データ1 4 4は関連する緯度および経度1 3 6～1 4 2によって規定されるセクション内に位置する任意の移動ユニット1 6に関連されるべき境界線2 2（図1を参照）を記述する。上に述べたように、境界線データ1 4 4は半徑として作用する図形を定義することができる。或いは、境界線データ1 4 4は緯度および経度を表すことができる。実際上、緯度および経度1 3 6～1 4 2は境界線データ1 4 4として働くことができる。

【0 0 4 1】図9および図1 1を参照すると、タスク1 3 0は移動ユニット1 6から受信されたばかりの位置デ

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ータによって示される記録1 3 4をデータベース1 3 2内に輸出するためにテーブルルックアップ動作を行なう。好ましい実施例においては、タスク1 3 0はデータベース1 3 2のデータエレメント1 4 4から適切な境界線データを単に読み取ただけである。この境界線データは前記位置データによって示される位置を囲む境界線2 2を規定するよう構成される。もし前記位置データが、例えば、ドップラパラメータおよびドップラパラメータの型式になっておれば、タスク1 3 0はデータベース1 3 2に対してテーブルルックアップを行なう前にそのようなパラメータを緯度および経度データに変換する。

【0 0 4 2】タスク1 3 0が境界線データを得た後、タスク1 4 6は境界線データ応答メッセージ9 0（図8を参照）を移動ユニット1 6に返送する。タスク1 4 6の後、ゲートウェイ1 4およびネットワーク1 0はノード1 0 8において受信された現在位置メッセージの処理を終了している。

【0 0 4 3】ゲートウェイ1 4はさらにその元の位置ができるだけ現在位置に近いことを保証するためにメンテナンス手順1 4 8を行なうことができる。タスク1 5 0に示されるように、手順1 4 8は好ましくはピークをはずれた(off-peak)トラフィック時にのみ行なわれる。言い換えれば、もしゲートウェイ1 4を介したネットワーク1 0における通信トラフィックがそのピーク容量に近くなっておれば、手順1 4 8は後に延期される。このようにして、手順1 4 8を実行することから生ずる通信が加入者が必要とするかもしれない通信資源を奪うことがなくなる。

【0 0 4 4】タスク1 5 2において、加入者データベース1 1 4（図1 0を参照）における記録1 1 6の時間スタンプ1 2 4がサーチされて古くなった元の位置データを有する現在登録されている加入者を探す。タスク1 5 2はその時間スタンプ1 2 4が現在時間に関して少なくとも所定の年齢を示すいずれかの記録1 1 6をサーチすることができる。古い記録が見つけれられ、タスク1 5 4は現在位置命令を示された移動ユニット1 6に送信し、かつ該移動ユニット1 6から応答を得、応答が受信されると、タスク1 1 0、1 1 2、1 2 8、1 3 0および1 4 6が上に述べたように実行されて元の位置および時間スタンプデータエレメント1 2 2および1 2 4を更新し、かつ移動ユニット1 6に新しい境界線データを送す。タスク1 4 6を行なった後、メンテナンス手順1 4 8は他の古い加入者記録1 1 6に関して繰り返すことができる。

【0 0 4 5】

【発明の効果】以上要するに、本発明は有線位置データを維持するために必要な通信の量を最少化する追跡システムを提供する。移動ユニットは境界線データによって動的にプログラムされ、かつ該境界線データは移動ユニットの位置に固くは連係しない。従って、本発明はそ

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の中で移動ユニットが動作できる様々な領域によって課される値の位置報告の必要性に対応できる。

【0046】以上のように本発明が好ましい実施例に関して説明された。しかしながら、当業者は本発明の範囲から逸れることなくこの好ましい実施例において変更および修正をなすことができることを認識するであろう。

例えば、好ましい実施例は移動ユニット16に対し位置信号を提供するためのGPS衛星ベース測位システムを使用することに関して説明されているが、他の測位システムまたは方法も使用できる。ここで用いられているように、用語「位置決定(position location)」は、衛星ベースであるいは地上ベースであれ、当業者に可能な他の位置決定手段および方法を含むものと考えている。LORANはすでに世界の多くの部分で利用可能な地上ベースとした測位システムの一つである。他の測位手段および方法も知られている。従って、当業者に明らかなこれらのおよび他の変更および修正は本発明の範囲内に含まれるものとする。

【図面の簡単な説明】

【図1】その中で通信ネットワークが動作する地域の領域を示す説明図である。

【図2】前記ネットワークと通信する移動ユニットを示すブロック図である。

【図3】前記ネットワークにおいてノードとして作用するゲートウェイを示すブロック図である。

【図4】前記移動ユニットによって行なわれるパワーアップ手順を示すフローチャートである。

【図5】前記移動ユニット内に維持される位置テーブルメモリ構造を示すブロック図である。

*【図6】前記移動ユニットによって行なわれる測位手順を示すフローチャートである。

【図7】前記移動ユニットによって送信される現在位置データメッセージを示すブロック図である。

【図8】前記ゲートウェイによって送信される境界線データメッセージを示すブロック図である。

【図9】前記ゲートウェイによって行なわれる手順を示すフローチャートである。

【図10】前記ゲートウェイ内に維持される加入省データベースメモリ構造を示すブロック図である。

【図11】前記ゲートウェイ内に維持される境界線データベースメモリ構造を示すブロック図である。

【符号の説明】

10 通信ネットワーク

12 人工衛星

14 ゲートウェイ

16 移動ユニット

18 政策的管轄区

20 2.2 境界線

24 衛星測位システム

26 送受信機

28 受信機

30 プロセッサ

32、42 入力/出力(I/O)セクション

34、44 タイマ

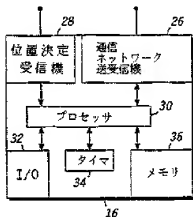
36、46 メモリ

38 送受信機

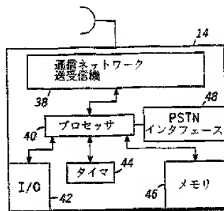
40 プロセッサ

48 PSTNインタフェース

【図2】



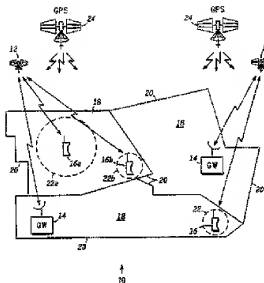
【図3】



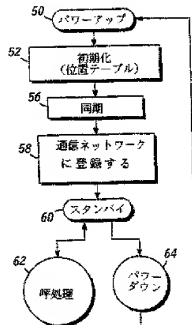
(9)

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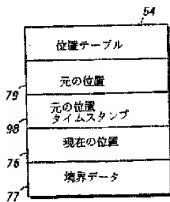
【図1】



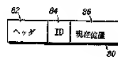
【図4】



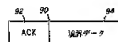
【図5】



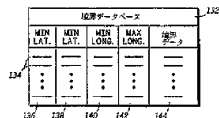
【図7】



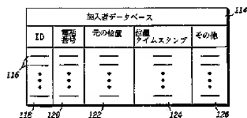
【図8】



【図11】



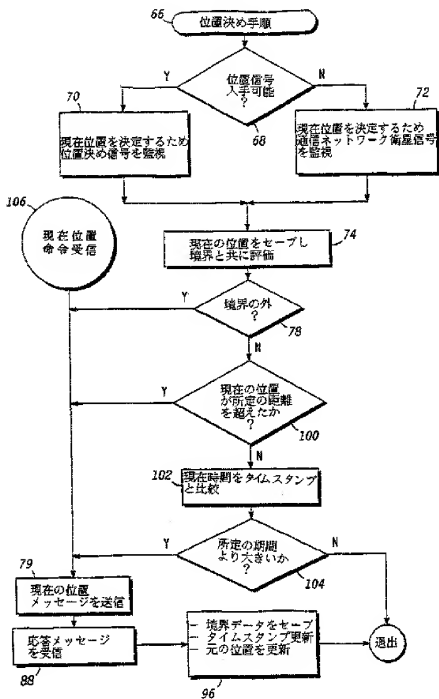
【図16】



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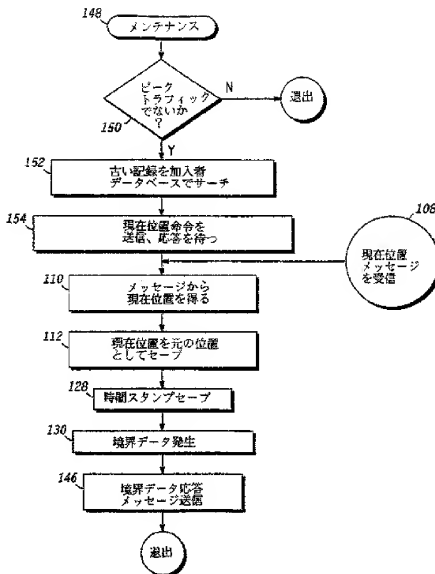
【図6】



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【図9】



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